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Syllogeus Series No. 46
(c) National Museums of Canada 1983
Printed in Canada
ISSN 0704-576X

Série Syllogeus n° 46
(c) Musée nationaux du Canada 1983
Imprimé au Canada

A CHECKLIST AND BIBLIOGRAPHY OF THE SIPUNCULA FROM CANADIAN AND ADJACENT WATERS

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K1A 0M8

Syllogeus No. 46

National Museum of Natural Sciences | Musée national des sciences naturelles

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Ottawa 1983

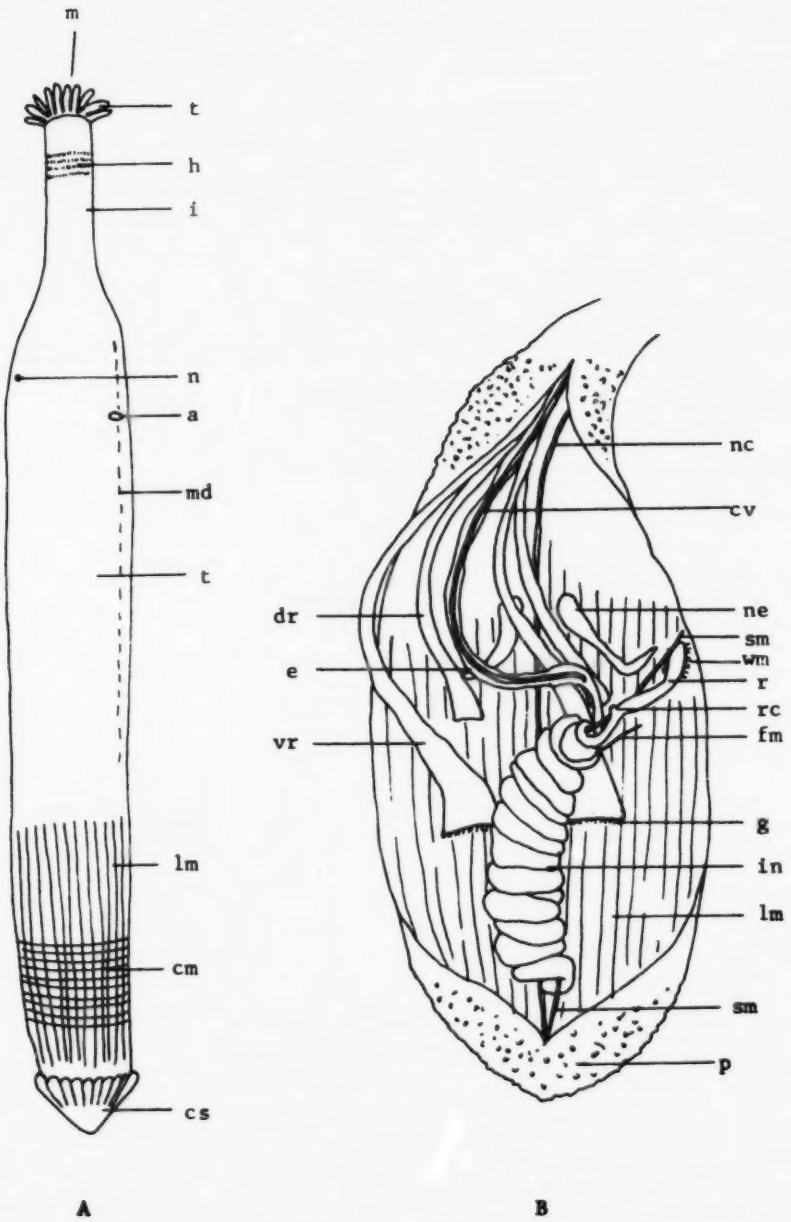

FIGURE 1: *External morphology (A) and internal anatomy (B) of a mythical generalized sipunculan, modified from Stephen and Edmonds (1972). a - anus; cm - circular muscle; cs - caudal shield; cv - contractile vessel; dr - dorsal retractor muscle; e - oesophagus; fm - fixing muscle; g - gonad; h - hooks; i - introvert; in - intestine; lm - longitudinal muscles; m - mouth; md - mid-dorsal line; n - nephridiopore; nc - nerve cord; ne - nephridium; p - papillae; r - rectum; rc - rectal caecum; sm - spindle muscle; t - tentacles; tr - trunk; vr - ventral retractor muscle; wm - wing muscle.*

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ABSTRACT

Brief descriptions with synonymies are given for the seventeen species of Sipuncula known to occur in Canadian and adjacent waters. Detailed distributions for the area covered in this paper are given along with general world-wide distributions. Maps of collection sites are included and the appendix is a list of the exact locations plotted on the maps and the sources of the information.

RÉSUMÉ

Dix-sept espèces de Sipunculiens ont été signalées dans les eaux maritimes du Canada et leurs parages. L'auteur donne de brèves descriptions et des synonymies pour chaque espèce. Ci-inclus, on trouve les localisations spécifiques dans le territoire d'investigation aussi bien que des généralités de la répartition universelle. L'annexe est une liste des localités indiquées sur les cartes de répartition et contient les sources de ces informations.

ACKNOWLEDGEMENTS

I would like to thank the following institutions and individuals for supplying specimens and/or information for inclusion in this paper: D.V. Ellis and B. Emerson, University of Victoria; P. Lambert, British Columbia Provincial Museum; J.W. Wacasey, Arctic Biological Station; M.J. Dadswell and V. Bailey, St. Andrews Biological Station; D.S. Davis, Nova Scotia Provincial Museum; M. Rice, United States National Museum; British Museum (Natural History).

C.G. Gruchy, Acting Director, National Museum of Natural Sciences, while he was Chief of the Invertebrate Zoology Division, encouraged me to write this and also obtained the information from the British Museum for me while he was visiting there. Dr. C.T. Shih and Mrs. Diana Laubitz, NMNS, reviewed the manuscript and made many helpful suggestions. Diana Laubitz translated the abstract.

A CHECKLIST AND BIBLIOGRAPHY OF THE SIPUNCULA FROM CANADIAN AND ADJACENT WATERS

INTRODUCTION

The Phylum Sipuncula is a small and cosmopolitan group of unsegmented marine worms found from the intertidal to great depths. The seventeen species discussed in this paper include all those known to occur in Canadian and adjacent waters.

The area considered includes, on the east coast, south to Cape Code (42°N) and east to 45°W, on the west coast, south to 45°N, west to 150°W and north to the Gulf of Alaska. In the north the area extends east to the west coast of Greenland and west to the eastern part of Alaska.

This paper is meant to be a guide for those wishing to know what species are recorded from Canadian waters. The species descriptions are modified from those given by others, principally Stephen and Edmonds (1972) and Cutler (1973). The synonyms listed for each species indicate revisions made since the publication of Stephen and Edmonds (1972) who give a more complete list of synonyms. The synonymy given here is compiled from several sources, including Cutler (1973), Cutler and Murina (1977), Cutler and Cutler (1980), Gibbs (1975, 1977a & b, 1982), and Murina (1973). Those wishing more complete information on the Phylum Sipuncula should consult the monographs mentioned below and in the bibliography. The bibliography includes papers on systematic problems in the phylum, species accounts, identification guides and accounts of invertebrate collections which helped plot the points on the maps. Not all of these papers are cited in the text or appendix.

One of the most comprehensive accounts of the phylum is given by Stephen and Edmonds (1972). They give a general account of the classification and include a glossary, keys and descriptions of most of the species. However, there are some errors and omissions. People working with material from the west coast should also consult Fisher (1952) which deals specifically with the sipunculans of California and Baja California but includes most of the species from British Columbia. Material from the east coast is covered in Gerould (1913) and Cutler (1973). Cutler (1977) gives a brief account of the species found from Maine to Virginia. A general account of the biology of the phylum is given by Hyman (1959).

The information on the distribution of sipunculans in Canadian and adjacent waters is taken from museum specimens, the literature and various other sources. Undoubtedly some

records have been missed. In a few cases I have received information about or identified species from areas where they have not been reported before. Where possible I have checked identifications before including the records on the maps. A diagrammatic illustration showing the external morphology and internal anatomy of a mythical, generalized sipunculan is also provided.

CLASSIFICATION

Phylum Sipuncula

Family Sipunculidae	Page	Map
Genus *Phascolopsis*		
Phascolopsis gouldii (Pourtalés, 1851)	10	1
Family Golfingiidae		
Genus *Golfingia*		
Subgenus *Golfingia*		
Golfingia (G.) birsteini Murina, 1973	10	2
Golfingia (G.) elongata (Keferstein, 1863)	11	1
Golfingia (G.) margaritacea (Sars, 1851)	12	6
Golfingia (G.) muricaudata (Southern, 1913)	13	5
Golfingia (G.) vulgaris (de Blainville, 1827)	13	3
Subgenus *Nephasoma*		
Golfingia (N.) capilleformis Murina, 1973	14	2
Golfingia (N.) diaphanes (Gerould, 1913)	15	1
Golfingia (N.) eremita (Sars, 1851)	16	7
Golfingia (N.) lilljeborgi (Danielssen and Koren, 1881)	17	5
Golfingia (N.) schuttei (Augener, 1903)	17	1
Golfingia (N.) vodjanitskii Murina, 1973	18	2
Subgenus *Thysanocardia*		
Golfingia (T.) catharinae (Grübe, 1868)	19	4
Golfingia (T.) pugettensis Fisher, 1952	20	4

	Page	Map
Genus *Phascolion*		
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Genus *Themiste*		
Themiste pyroides (Chamberlin, 1919).....	22	3
Family Phascolosomatidae		
Genus *Phascolosoma*		
Subgenus *Phascolosoma*		
Phascolosoma (P.) agassizii (Keferstein, 1867).....	23	9

SPECIES ACCOUNTS

Family SIPUNCULIDAE

Phascolopsis gouldii (Pourtalès, 1851) (Map 1)

Sipunculus gouldii Pourtalès, 1851:40.

Phascolopsis gouldii: Stephen and Edmonds, 1972:75. Cutler, 1973:131.

Description: Trunk length up to about 130 mm although longer specimens have been recorded. The introvert is about one third the length of the trunk, with many tentacles but no hooks. The skin is covered with very small skin bodies. Large specimens may be opaque and whitish grey, yellow or pink but small specimens are usually transparent and whitish or pink. The longitudinal muscles are gathered into 30 - 40 anastomosing bands. The dorsal pair of retractor muscles originates just behind the anus and the ventrals further posteriorly but in the anterior half of the trunk. The intestine is made up of 35 - 40 coils and is attached by four fixing muscles to the ventral body wall and wing muscles on the rectum. The spindle muscle is not attached posteriorly. There is a rectal caecum. The nephridia are free and open in front of the anus.

Type locality: Massachussetts.

Distribution: Area records: St. Lawrence River estuary; Minas Basin; Bay of Fundy; Casco Bay, Maine.

Other records: It has been found along the east coast of North America south to Florida.

Family GOLFINGIIDAE

Golfingia (Golfingia) birsteini Murina, 1973 (Map 2)

Golfingia birsteini Murina, 1973:942.

Description: Trunk approximately 25 mm long, 1.5 mm wide. The introvert is almost as long as the trunk. A single row of 8 - 10 tentacles surrounds the mouth. Eye spots are lacking. There are irregularly scattered hooks on the introvert ranging in height from 0.025 mm to 0.1 mm, the tallest being nearest the mouth. The trunk is semi-transparent, yellowish and the posterior portion is wrinkled. There are digitate papillae 0.022 mm high at the base of the introvert and the posterior end of the body, with shorter papillae in the middle of the trunk

and on the introvert. There are two pairs of retractor muscles, of which the ventral pair attaches in the anterior quarter of the trunk very close to the ventral nerve cord and the dorsal pair attaches close behind the anus at a considerable distance from the nerve cord. They unite far forward near the tentacles. The intestinal spiral of about 30 coils is not attached to the posterior end of the trunk by the spindle muscle. The rectum is short and there is a caecum. The short nephridia open in front of the anus and are not attached to the body wall.

Type locality: Northeast Pacific Ocean, 57°31'17"N, 148°34'5"W.

Distribution: Area record: Northeast Pacific Ocean, 57°31'17"N, 148°34'5"W, at 3200 m. This is the only published record of this species.

Golfingia (Golfingia) elongata (Keferstein, 1863) (Map 1)

Phascolosoma elongatum Keferstein, 1863:39.

Phascolosoma cylindratum Keferstein, 1865:428.

Phascolosoma charcoti Hérubel, 1906:127.

Phascolosoma derjugini Gadd, 1911:82.

Golfingia charcoti: Stephen and Edmonds, 1972:89. Cutler and Murina, 1977:175.

Golfingia cylindrata: Stephen and Edmonds, 1972:89. Cutler and Murina, 1977:175.

Golfingia elongata: Stephen and Edmonds, 1972:90. Cutler, 1973:134. Cutler and Murina, 1977:175.

Description: Length 2 - 150 mm with a cylindrical trunk. The introvert is about half the length of the trunk. A single row of paired tentacles (16 - 36) surrounds the mouth. There are two eye spots. Simple hooks are arranged in 15 - 25 rings although larger specimens are likely to have as few as 3 - 5 rings. The skin is smooth anteriorly but there are some skin bodies on the posterior end. There are two pairs of retractor muscles. The ventral pair originates near the middle of the trunk and the dorsal pair around the same level as the anus. The intestine has 30 - 35 coils and is not attached to the posterior body wall by a spindle muscle. There is usually a rectal caecum. There may be two fixing muscles from the anterior intestinal coils and rectum to the body wall but these are frequently missing. The contractile vessel is simple. The two nephridia are free from the body wall for their entire length.

Type locality: St. Vaast la Hougue, France.

Distribution: Area records: 47°51'N, 51°50'W

Other records: This species is fairly common in the eastern Atlantic from the Arctic to the Mediterranean. In the western Atlantic it has been reported from off Newfoundland; Woods Hole, Massachusetts; Key West, Florida and Cuba. The species has been recorded at depths down to about 179 m.

Golfingia (Golfingia) margaritacea (Sars, 1851) (Map 6)

Sipunculus margaritaceus Sars, 1851:196.

Phascolosoma profundum Roule, 1898:385.

Phascolosoma inigum Sluiter, 1912:14.

Golfingia cantabriensis Edmonds, 1960:163. Stephen and Edmonds, 1972:86. Cutler and Murina, 1977:176.

Golfingia inigua: Stephen and Edmonds, 1972:93. Cutler and Murina, 1977:176.

Golfingia margaritacea: Stephen and Edmonds, 1972:94. Cutler, 1973:136.

Golfingia profunda: Stephen and Edmonds, 1972:104. Cutler and Murina, 1977:176.

Description: This species may reach 300 mm in length but is usually shorter. The introvert is about half the length of the trunk and there may be up to about 100 tentacles, although this number of tentacles is usually found only in large specimens. There are no introvert hooks. The trunk is greyish-white to dark reddish-brown and the skin is covered with small, flat papillae. There are two pairs of retractor muscles. A ventral pair of retractor muscles originates in the middle third of the trunk and the dorsal pair in the anterior third. The intestinal coil is not attached to the posterior body wall by the spindle muscle but there are usually two or three fixing muscles anteriorly. The short rectum has a caecum. The nephridia are short, free from the body wall and open anterior to the anus.

Type locality: Finmark, Norway.

Distribution: Area records: In the Arctic from Baffin Island; Southampton Island and the eastern Beaufort Sea. In the Atlantic off Newfoundland; Cape Breton Island; and the Gulf of St. Lawrence. In the Pacific, the Gulf of Alaska; British Columbia; Juan de Fuca Strait and the Olympic Peninsula of Washington.

Other records: This species is found in all oceans of the world but is mainly temperate and

polar. It has been found down to 4600 m but is generally in shallower water.

Remarks: This species has many subspecies but their morphological constancy and nomenclatural value is questionable (Stephen and Edmonds, 1972; Cutler, 1973).

Golfingia (Golfingia) muricaudata (Southern, 1913) (Map 5)

Phascolosoma muricaudatum Southern, 1913b:21.

Phascolosoma hudsonianum Chamberlin, 1920:3D.

Golfingia muricaudata: Stephen and Edmonds, 1972:100. Cutler, 1973:133.

Description: Trunk up to about 70 mm, with the introvert about half the length of the trunk. A caudal appendage up to about 7 mm long is present. The introvert has 25 - 30 tentacles. Adults lack hooks but they are present in immature specimens. Papillae are scattered among the hooks and over the trunk, becoming larger near the posterior end. The skin is translucent, cream-coloured or pale brown. There are two pairs of retractor muscles. The slender dorsal pair arises in the vicinity of the anus and the stronger ventrals originate near the middle of the trunk. The intestinal coil is unattached posteriorly and there is no caecum. The nephridia are unattached and about one quarter the length of the trunk. The nerve cord does not extend into the tail.

Type locality: Southwest coast of Ireland.

Distribution: Area records: Western Hudson Bay and southern British Columbia. Other records: Eastern North Atlantic south to West Africa; western North Atlantic south to Cape Hatteras; South Atlantic at the Falkland Islands and Bouvet Island; Indian Ocean off southeast Africa; North Pacific. Recorded at depths down to 4400 m.

Golfingia (Golfingia) vulgaris (de Blainville, 1827) (Map 3)

Sipunculus vulgaris de Blainville, 1827:312.

Phascolosoma kolense Gadd, 1911:80.

Golfingia kolensis: Stephen and Edmonds, 1972:93. Cutler and Murina, 1977:177.

Golfingia vulgaris: Stephen and Edmonds, 1972:110. Cutler and Murina, 1977:177.

Description: Trunk up to about 100 mm and cylindrical in shape. The skin is covered with very small skin bodies and anteriorly and posteriorly on the trunk there are zones of papillae, which are often dark coloured. The introvert is slightly shorter than the trunk and thinner. Large specimens may have 150 tentacles around the mouth in several rows but there are usually fewer. Behind the tentacles there is an area of smooth skin followed by a zone of simple, dark, scattered hooks. The longitudinal muscles of the body wall are continuous. The ventral pair of retractor muscles arises from the middle third of the trunk and the dorsal pair arises posterior to the anus. The spindle muscle does not attach to the posterior body wall but the anterior end of the intestinal coil is attached by three fixing muscles. There is a rectal caecum. The nephridia are free from the body wall and reach to the roots of the ventral retractors. The nephridiopores are just anterior to the anus.

Type locality: Dieppe, France.

Distribution: Area records: Northern British Columbia; Strait of Georgia and Juan de Fuca Strait.

Other records: This species is found in Greenland; from northern Europe to West Africa; the eastern Mediterranean; Zanzibar; Antarctica; Indo-West Pacific and eastern Pacific. It has been recorded from the intertidal to about 2000 m.

Remarks: The external form of this animal is variable, and about six subspecies are recognized.

Golfingia (Nephasoma) capilleformis Murina, 1973 (Map 2)

Golfingia capilleformis Murina, 1973:943.

Description: This is a long thin animal with a trunk length of 3 - 19 mm and thickness of 0.1 - 0.9 mm. The introvert may be from 2.5 - 12.5 mm long and 0.1 - 0.38 mm thick. There are four tentacular lobes at the tip of the introvert and the introvert bears a band of irregularly spaced, single pointed hooks about 0.20 - 0.25 mm high and 0.01 mm at the base. There are no eye spots and the body wall is smooth, thin and transparent. The skin is covered with small rounded papillae which are more closely arranged in the posterior part of the trunk. The single pair of retractor muscles is attached to the body wall in the anterior or middle third of the trunk. The nephridiopores open just behind the anus. The intestine is made up of 40 - 50 coils and is not attached to the posterior body wall by the spindle muscle. The wing muscle of the rectum is weak.

Type locality: North Pacific: 56°09'09"N, 139°12'16"W.

Distribution: Area records: West of the Alexander Archipelago, Alaska. Other records: This species has also been found in the South Pacific near Tongatapu Island; Tahiti and northeast of New Zealand. Depths range from 920 m to 3450 m.

Golfingia (Nephasoma) diaphenes (Gerould, 1913) (Map 1)

Phascolosoma diaphenes Gerould, 1913:395.

Golfingia diaphenes: Gibbs, 1975:80. Cutler and Cutler, 1980:201.

Description: This is a small, variable species with a trunk length usually less than 10 mm. The introvert is the same length as the trunk, has short tentacular lobes and scattered hooks. The skin is usually thin and transparent and may be whitish or pinkish. Papillae are found all over the trunk but are usually more dense posteriorly and anteriorly. There are two retractors which may originate from a variety of locations. The spindle muscle is not attached posteriorly and there is a rectal caecum. The nephridiopores open at the same level as, or slightly anterior to, the anus.

Type locality: South of Georges Bank, east coast of North America.

Distribution: Area records: Off the coasts of Labrador and Newfoundland; Georges Bank. Other records: Generally a bipolar, coldwater species. It has been recorded from the North Atlantic; Mediterranean; West Africa; South Africa; the Antarctic; northwest Pacific; both coasts of Central America; Ecuador; Peru; Chile; Australia; and New Zealand. In tropical regions it is found in very deep, cold water and has been recorded down to 6326 m. It is generally in less than 200 m at latitudes greater than 40° (Cutler and Cutler, 1980).

Remarks: This species is almost indistinguishable from *G. minuta*. However *G. minuta* is hermaphroditic and generally found in shallow waters of the eastern Atlantic whereas *G. diaphenes* is dioecious and more widespread.

The name *G. diaphenes* was first suggested by Gerould (1913) for the dioecious animals but was largely forgotten until Gibbs (1975) studied the breeding biology of *G. minuta* and again proposed the separation of hermaphroditic and dioecious forms. Cutler and Cutler (1980) suggested that if gametes cannot be found, the two species may be separated by the diameter/length ratio of the trunk (1 to 4 or 5 for *G. minuta* and 1 to 8 - 10 for *G. diaphenes*), the nature of the body wall (*G. minuta:* whitish, thick, opaque; *G. diaphenes:* very thin, transparent, colorless or pinkish) and by the position of the

anus (*G. minuta:* anterior to nephridiopore; *G. diaphenes:* at the same level as, or just posterior to, nephridiopore). Because these two species are so similar, it is probable that many "*G. minuta*" identified from eastern North America in the past were, in fact, *G. diaphenes*. However, without examining each individual it is impossible to differentiate the two from literature records.

Golfingia (Nephasoma) eremita (Sars, 1851) (Map 7)

Sipunculus eremita Sars, 1851:197.

Golfingia eremita: Stephen and Edmonds, 1972:141. Cutler, 1973:150. Cutler and Murina, 1977:182.

Description: Trunk length up to about 50 mm and 3 to 4 times as long as thick. The introvert is about the same length as the trunk. There are about 20 tentacles and hooks are absent. Colour varies from dark reddish brown or creamy tan in large, to whitish or transparent in small specimens. The skin appears smooth but is covered with many small papillae. A single pair of retractor muscles arises in the middle of the trunk. Connective tissue attaches the oesophagus to the retractors and there is a single fixing muscle to the first intestinal coil. A spindle muscle may be present or absent. The nephridia are short and open at the same level as, or just anterior to, the anus.

Type locality: Northwest coast of Norway.

Distribution: Area records: Southern Greenland; Baffin Island; off Labrador; Newfoundland; Nova Scotia; Gulf of Maine. There is a specimen in the collection of the British Columbia Provincial Museum from Mill Bay, Vancouver Island which may be this species.

Other records: Arctic waters of Europe and North America, including Norway, Iceland and Greenland; east coast of North America south almost to Cape Hatteras; South Africa; Argentina southeast of the Rio de la Plata estuary; south of Tierra del Fuego; Antarctica.

Stephen and Edmonds (1972) incorrectly cite Chamberlin (as Chamberlain) (1920) as stating that this species is found in northwest Canada. Chamberlin says that it is found along the eastern North American coast south to 40°N, but no mention is made of northwestern localities.

Remarks: According to Stephen and Edmonds (1972) two of the subspecies, *G. e. australis* and *G. e. californica*, always have a spindle muscle while it is often lacking in

G. e. eremita. A fourth subspecies, *G. e. scabra*, is characterized by a loose, thick, coffee-coloured cuticle which easily rubs off. They speculate that this could be an artifact of the preservative and therefore the status of the last subspecies is questionable.

Golfingia (Nephasoma) lilljeborgi (Danielssen and Koren, 1881) (Map 5)

Phascolosoma lilljeborgi Danielssen and Koren, 1881:63.

Onchnesoma glaciale Danielssen and Koren, 1881:64.

Phascolosoma anceps Théel, 1905:84.

Nephasoma marinka Pergament, 1946:189. Cutler and Murina, 1977:182.

Golfingia glacialis: Stephen and Edmonds, 1972:144. Cutler and Murina, 1977:176.

Golfingia lilljeborgi: Gibbs, 1982:121.

Description: Total length up to about 60 mm, half of which may be made up by the introvert. There is a pair of short, dorsal tentacles and six lobes around the mouth. There are irregularly scattered, small, blunt, triangular hooks on the anterior introvert and the skin of the introvert and trunk is smooth. A single pair of retractor muscles arises from between a half and three quarters of the length along the trunk. They are joined for most of their length. The intestine is made up of many coils and the spindle muscle is either absent or weakly developed. There are no fixing muscles or rectal caecum. The two nephridia open just posterior to the anus.

Type locality: North Atlantic and Arctic Oceans, between 63°N and 72°N and 8°W and 26°E.

Distribution: Area records: Beaufort Sea; Strait of Georgia, British Columbia. Other records: Greenland; Norwegian coast; Gascogne; Mediterranean. It has been recorded down to 2750 m.

Golfingia (Nephasoma) schuttei (Augener, 1903) (Map 1)

Phascolosoma schuttei Augener, 1903:335.

Golfingia schuttei: Stephen and Edmonds, 1972:156.

Description: Trunk up to about 70 mm and the introvert is about as long as the trunk. Stephen and Edmonds (1972) say that the skin is spotted brown while Cutler and Cutler (1980) say that the skin is tan to grey-brown with a suggestion of longitudinal banding near the

introvert base. The introvert has several rows of tentacles and brown, slightly bent hooks. The skin is covered with mushroom or finger-shaped papillae. The longitudinal muscles of the body wall form a continuous sheet although one or two strands may be visible behind the insertions of the retractor muscles. The single pair of retractor muscles arises from the posterior two thirds of the trunk; the muscles are joined by mesenteries for their anterior two thirds. There are about 63 intestinal coils and a spindle muscle which splits in the last intestinal coil. There are several fixing muscles including one that starts from the anterior part of the trunk to the left of the nerve cord and retractor and attaches to the first coil; a second that starts behind the anus to the left of the nerve cord and attaches to the first coil; and a third that starts from a third to a quarter of the way up the introvert and attaches to the intestine. The contractile vessel is simple. The rectum has a caecum and is attached to the body wall by a mesentery and wing muscles. The nephridia are about half the length of the trunk and not attached to the body wall. They open in front of the anus. The nerve cord is split anteriorly into several strands.

Type locality: Sydney, Australia.

Distribution: Area records: Off the coast of Labrador.

Other records: Mediterranean; southwest Atlantic from the South Shetlands to southern Argentina; North Pacific; west coast of South America from Columbia to Chile; New South Wales; Tasmania. Cutler and Cutler (1980) report that there are many unpublished records from west and southwest Africa, eastern United States and Uruguay.

Golfingia (Nephasoma) wodjanizkii Murina, 1973 (Map 2)

Golfingia wodjanizkii Murina, 1973:944.

Description: This species was described from a single specimen, and the following is taken from the type description.

The trunk is 6.5 mm long and 1 mm in diameter, and the introvert is 16.5 mm long and 0.3 mm in diameter. There are two eye spots. The introvert has hooks 0.01 - 0.005 mm wide at the base. The trunk is light yellow in colour with indistinct shields at both ends. The anterior shield is made up of small brown papillae in 25 to 30 rows with the introvert in the middle. The posterior shield is rounded with an elevated central apex with radiating furrows. The body wall is thin, transparent and has about 50 thin, longitudinal grooves at the level of the anus. There are low rounded papillae on the introvert and large digitate papillae at the base

of the introvert near the anterior shield. There are short digitate papillae bunched in the centre of the posterior shield and the trunk is covered with small, flat, round skin bodies. The two retractor muscles are attached by two wide roots in the posterior quarter of the trunk. The intestine is made up of 30 coils and is not attached posteriorly, although a loop of the intestine is attached to the body wall to the left of the nerve cord by two thin fixing muscles. The long, thin rectum is attached by poorly developed wing muscles. The nephridia are unattached and open behind the anus. In the only known specimen, the left nephridium is 1 mm long and the right is 0.05 mm.

Type locality: Northeastern Pacific, 55°20'5"N, 134°49'5"W.

Distribution: Area records: West of Prince of Wales Island, Alaska. A specimen in the collection of the National Museum of Natural Sciences from the Strait of Juan de Fuca may be this species.

Other records: Apparently the only record is for the type locality at 1110 m.

Remarks: A sipunculid in the collection of the National Museum of Natural Science may belong to this species. However it is not well preserved. The trunk is about 5.5 mm long and 1.5 mm in diameter with an anterior and posterior shield. The introvert, which is withdrawn, is in the middle of the anterior shield. The body wall is transparent except for several white, opaque spots on the anterior dorsal surface. Internal structures are poorly preserved and some were damaged when dissection was attempted. The body cavity is filled with eggs. The two retractors originate in the posterior third or quarter of the trunk and there appears to be an intestinal loop. One short, free nephridium was seen; there may have been a second hidden by other structures. Further dissection was not attempted because of the poor state of preservation.

This specimen was collected in Juan de Fuca Strait (48°18.5'N, 123°12.8'W) at about 42 m.

Golfingia (Thysanocardia) catharinae (Grübe, 1868) (Map 4)

Phascolosoma catharinae Grübe, 1868:48.

Phascolosoma procerum Möbius, 1875:157.

Phascolosoma semperi Selenka, de Man and Bulow, 1883:37.

Phascolosoma pavlenkoi Ostroumov, 1909:319.

Golfingia catharinae: Stephen and Edmonds, 1972:122. Cutler, 1973:146. Cutler and Murina, 1977:175.

Golfingia procera: Stephen and Edmonds, 1972:129. Cutler, 1973:149. Gibbs, 1977a:20. Cutler and Murina, 1977:175.

Golfingia semperi: Stephen and Edmonds, 1972:130. Cutler, 1973:149. Cutler and Murina, 1977:175.

Golfingia pavlenkoi: Stephen and Edmonds, 1972:152. Cutler and Murina, 1977:175.

Description: The trunk may reach 60 mm and the introvert may be from one to two times the length of the trunk. There may be over 100 tentacles in 8 to 14 paired rows. Small, dark papillae are scattered over the body surface, although they may occasionally be honey-coloured. The skin is light grey to creamy white but may have patches of the epidermis rubbed off. In larger specimens in particular the body surface may be wrinked. The two retractor muscles originate in the posterior quarter of the trunk. The contractile vessel lies alongside the oesophagus and is covered with many bifurcated villi. At the anterior end and in small animals the villi are usually simple. The intestine is composed of up to 25 double coils and there is a fixing muscle to the body wall. A strong wing muscle is present and the muscle does not attach to the body wall posteriorly. Cutler (1973) observed a rectal caecum in one specimen. The nephridia may be up to one half the trunk length and are free from the body wall for their whole length. The nephridiopores open in front of the anus in large individuals and near the same level as the anus in small individuals.

Type locality: Desterro, Brazil.

Distribution: Area records: Mill Bay, Saanich Inlet, British Columbia.
Other records: North Atlantic; West Indies; Azores; Brazil; around Africa into the southwestern Indian Ocean; Korea; Japan; Philippines; Australia; southern California; Peru; Chile. It has been recorded down to 3500 m.

Golfingia (Thysanocardia) pugettensis Fisher, 1952 (Map 4)

Golfingia pugettensis Fisher, 1952:401. Stephen and Edmonds, 1972:129.

Description: The introvert is as long as, or longer than, the trunk, and covered with numerous filiform tentacles but no hooks. The trunk is covered with small papillae, visible

under magnification, and the skin is light to dark sepia and finely wrinkled. The single pair of retractor muscles arises in the posterior third of the trunk. The intestinal spiral has at least 48 single coils and the posterior end of the oesophagus is attached to the dorsal trunk wall by a strong fixing muscle. The contractile vessel has branched villi which are confined to the free part of the vessel and a very short distance forward between the retractors. There is a rectal caecum. The nephridia are short, free and open in front of the anus.

Type locality: Dogfish Bay, Puget Sound, Washington

Distribution: Area records: Southern Alaska; British Columbia; Puget Sound, Washington.

Other records: This species has not been reported outside the area.

It has been recorded down to 192 m.

Phascolion strombi (Montagu, 1804) (Map 8)

Sipunculus strombus Montagu, 1804:74.

Phascolion tubicola Verrill, 1873:99.

Phascolion alberti Sluiter, 1900:9. Stephen and Edmonds, 1972:170.

Phascolosoma intermedium Southern, 1913a:3.

Golfingia intermedia: Stephen and Edmonds, 1972:147. Gibbs, 1977b:109. Cutler and Murina, 1977:182.

Phascolion strombi: Stephen and Edmonds, 1972:187. Cutler, 1973:168. Gibbs, 1977a:22.

Phascolion tubicolum: Stephen and Edmonds, 1972:190.

Description: The body shape is variable and assumes the shape of the tube inhabited by the animal. The trunk may be up to 20 mm and the introvert is usually longer. There are 16 - 26 tentacles around the mouth and behind that a region of randomly arranged hooks. The tip of the introvert may be swollen and bulb-like. On the trunk at the base of the introvert there is a region of dense papillae of variable colour and shape. They may be slender, dome-shaped, or flat, and red, dark grey, or white. There is usually a region of large, dark attachment papillae which may cover most of the trunk or be restricted to patches in various regions of the trunk. The papillae have a chitinous border and may be V-shaped, U-shaped or circular with several pointed projections usually directed anteriorly. The two retractor muscles are unequal in size. The dorsal is broad and the ventral is weaker with two roots that may straddle the ventral nerve cord. The digestive tract has five very open loops and is attached

to the trunk by several fixing muscles. The contractile vessel is simple and there is a rectal caecum. A single nephridium opens posterior to the anus.

Type locality: South coast of Devonshire, England.

Distribution: Area records: In the Arctic it has been recorded from the Beaufort Sea; Lancaster Sound; Baffin Bay; off Baffin Island; southern Greenland. In the Atlantic it has been recorded from the coast of Labrador; off Newfoundland; Gulf of St. Lawrence; Northumberland Strait; the continental shelf off Nova Scotia; Bay of Fundy; Minas Basin; Gulf of Maine. Gulf of Maine locations are not shown on the map but readers are referred to Figure 46 in Cutler, 1973.

Other records: Common throughout the Atlantic Ocean. It has also been reported from the Red Sea and Chile. It is found in very shallow water down to 3800 m.

Remarks: This species has a highly variable external appearance which is influenced by the type of shell inhabited. It is commonly found in gastropod and scaphopod shells but is also found in many other types of tubes. Gerould (1913) described seven subspecies based primarily on external characters but they are probably not valid (Stephen and Edmonds, 1972; Cutler, 1973).

Themiste pyroides (Chamberlin, 1919) (Map 3)

Dendrostoma pyroides Chamberlin, 1919:31.

Themiste pyroides: Stephen and Edmonds, 1972:210.

Description: The introvert is cylindrical, one half to one third the length of the trunk. The anterior third of the introvert is red-brown to purplish and glossy, the middle third is covered with dark brown, curved hooks and the posterior third is smooth. The highly dendritic tentacles are in four main branches each of which consists of two main stems with a minor branch between them. The trunk is pear-shaped, usually over 120 mm long and covered with small brown spots. The two retractor muscles originate in the middle of the posterior third of the trunk. The spindle muscle is attached behind the anus and a rectal caecum is present. The contractile vessel on the dorsal surface of the oesophagus gives off anastomosing branches forming a network. There are two long nephridia.

Type locality: Laguna Beach, Orange County, California.

Distribution: Area records: Southeast Alaska; British Columbia; Olympic Peninsula, Washington.

Other records: Oregon; California; Baja California.

Family PHASCOLOSOMATIDAE

Phascolosoma (Phascolosoma) agassizii Keferstein, 1867 (Map 9)

Phascolosoma agassizii Keferstein, 1867:46. Stephen and Edmonds, 1972:292.

Description: Specimens up to 140 mm when expanded but usually half that length. The introvert makes up about half the total length. There are 18 - 24 tentacles and 15 - 25 rows of hooks. The first 5 rows of hooks are small and colourless and the last one or two may be incomplete. Two eye spots are present. The trunk is cylindrical and the posterior bluntly pointed. The trunk wall may be translucent or opaque and the skin colour varies from pinkish grey, yellowish grey, pale sepia to reddish brown. Light coloured animals often have dark or reddish brown spots on the body while the introvert has dark coloured bands on the dorsal surface. Dark conical or convex papillae give the skin a rough appearance. The papillae are smallest midventrally and increase in size dorsally, especially posteriorly and just in front of the anus. In the area around the anus they are dark brown, conical or acorn shaped. The longitudinal muscles of the trunk wall are in 20 - 25 anastomosing bands at the level of the base of the retractors. Two pairs of retractor muscles originate in the posterior third of the trunk with the dorsals somewhat in front of the ventrals. The dorsals usually arise from bands 4 - 7 and the ventrals from bands 6 - 7. A single fixing muscle with two slender roots originates from band 1 at the level of the roots of the dorsal retractors and inserts by two distal branches on the rectum and the beginning of the intestinal coils. The spindle muscle originates in front of the anus and attaches to the posterior end of the trunk. The nephridia are about half the length of the trunk and attached for most of their length. The contractile vessel is inconspicuous. An intestinal caecum is present.

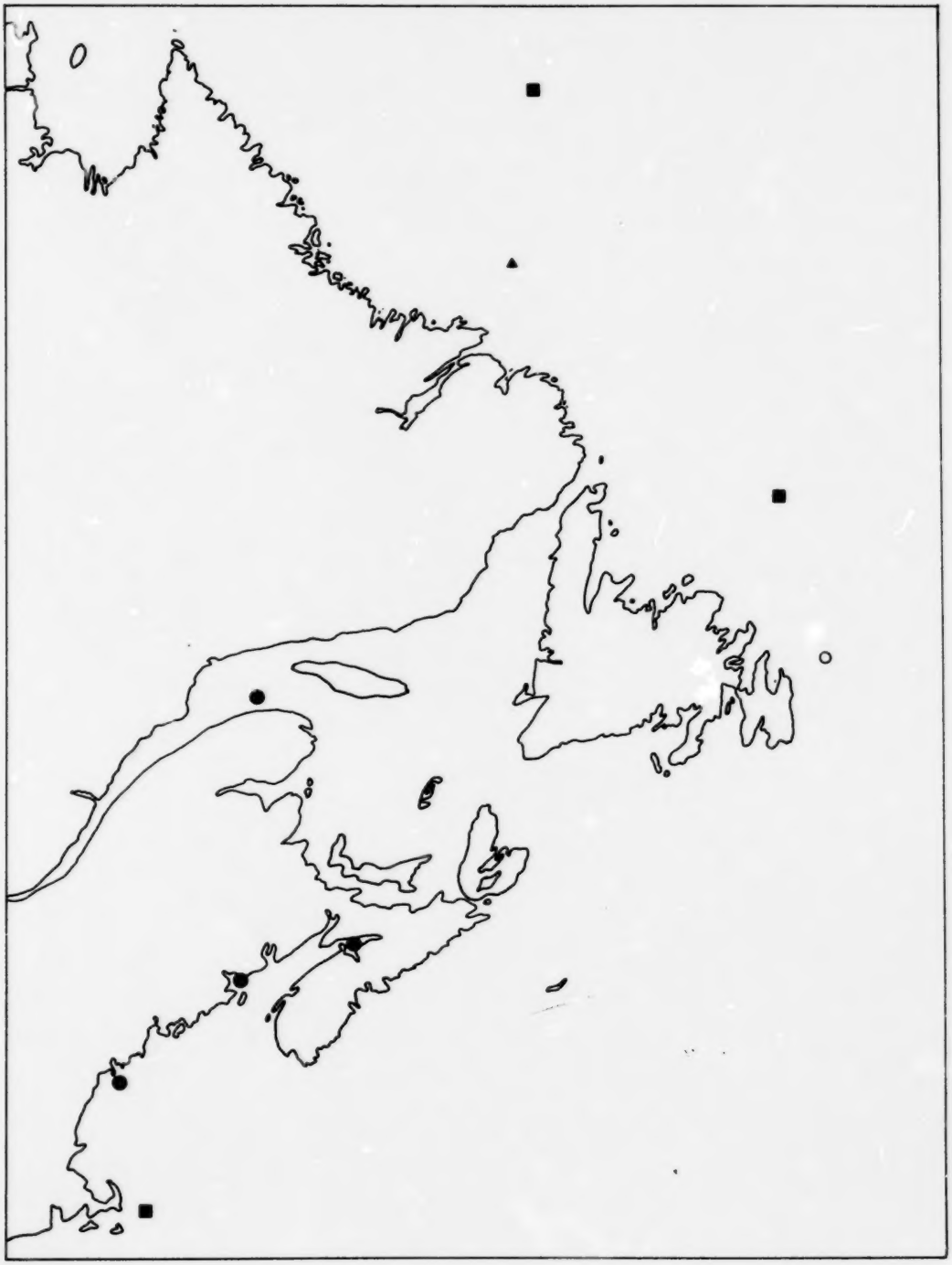
Type locality: Mendocino, California.

Distribution: Area records: Pacific coast, from southeast Alaska south to Washington. Other records: The west coast of North America south to Baja California. The National Museum of Natural Sciences has a specimen from Sachs Harbour, Banks Island, Northwest Territories but the authenticity of the data with the specimen is questionable.

Remarks: Stephen and Edmonds (1972) give the distribution as being almost world-wide, although Fisher (1952) states that most of the world-wide records are probably not *P.*

agassizii but a similar warm water species, *P. puntarenae*.

Chamberlin (1920) claimed to have examined another similar species, *P. japonicum*, from Ucluelet, Vancouver Island. However, when Fisher (1952) examined those specimens, he determined that they were one of the variations of *P. agassizii*. Fisher was unable to check the identity of the *P. japonicum* which Chamberlin reported from the Queen Charlotte Islands in the same paper but all other specimens Fisher examined from the same area were designated by him as *P. agassizii*.

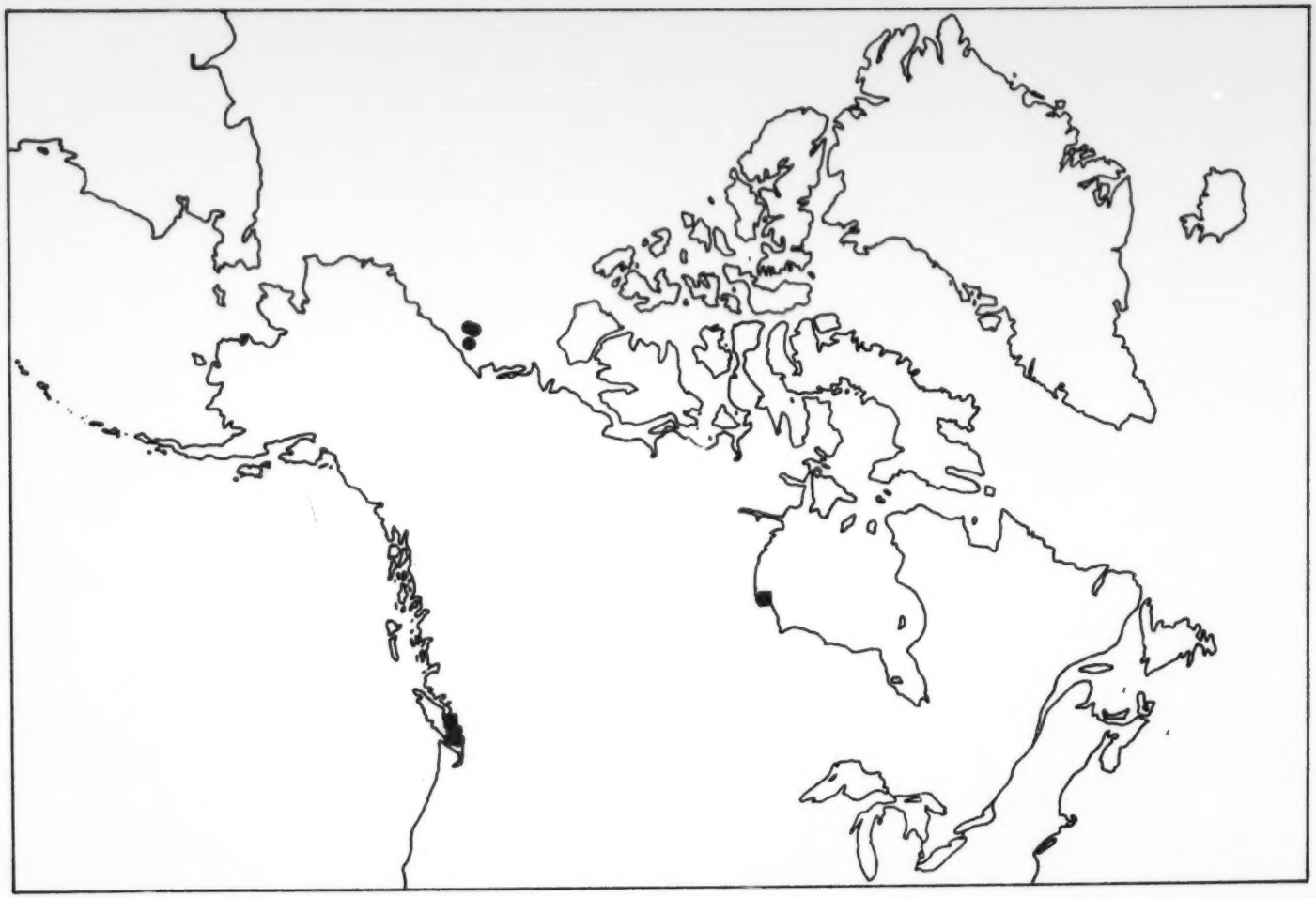


MAP 1: *Phascolopsis gouldii* ● ; *Golfingia (G.) elongata* ○ ; *Golfingia (N.) diaphanes* ■ ; *Golfingia (N.) echuttei* ▲ .

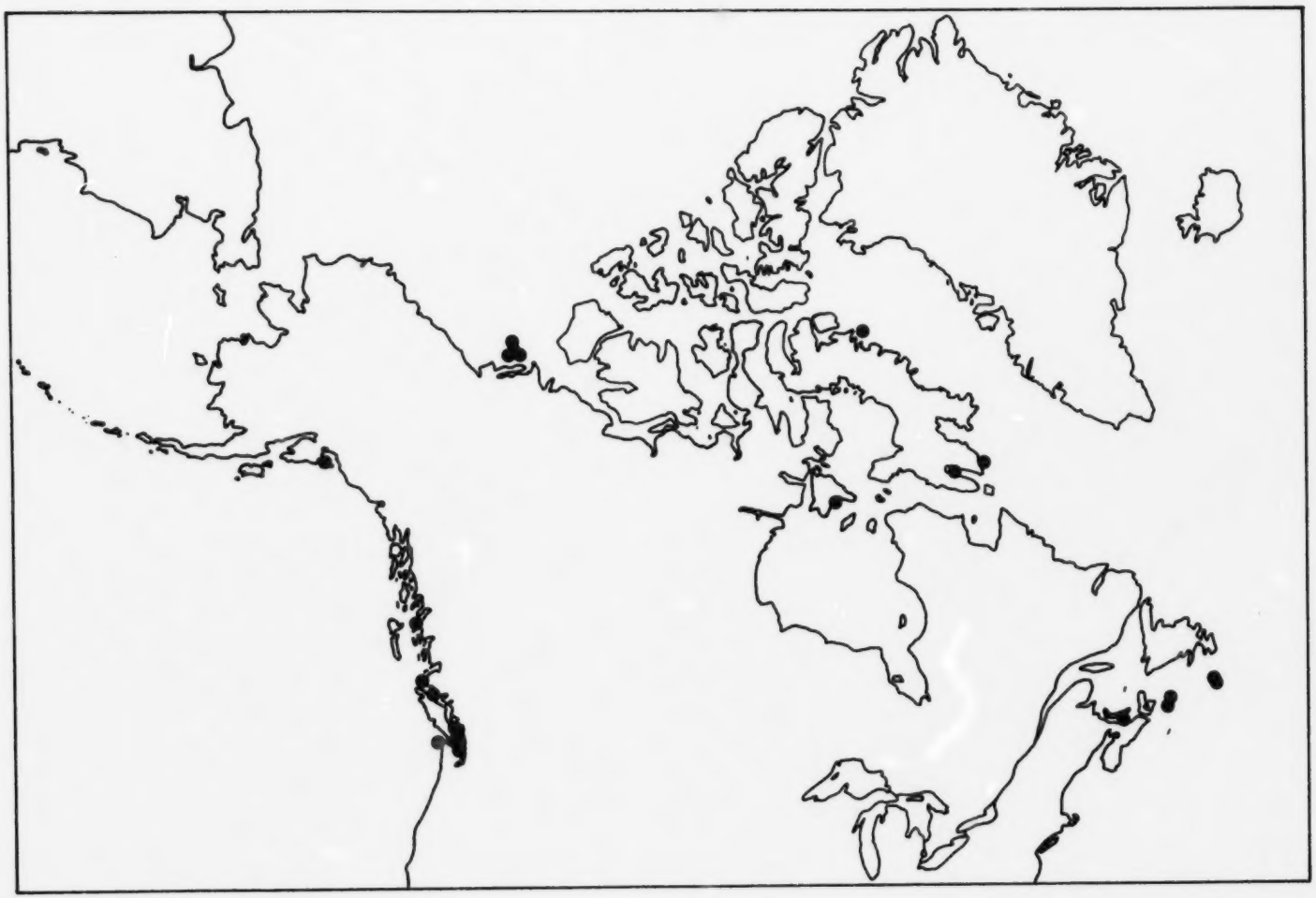
MAP 2: *Golfingia (G.) birsteini* ● ; *Golfingia (N.) capilleformis* ■ ; *Golfingia (N.) wodjaniszkii* ▲ .

MAP 3: *Golfingia (G.) vulgaris* ● ; *Themiste pyroides* ■ .

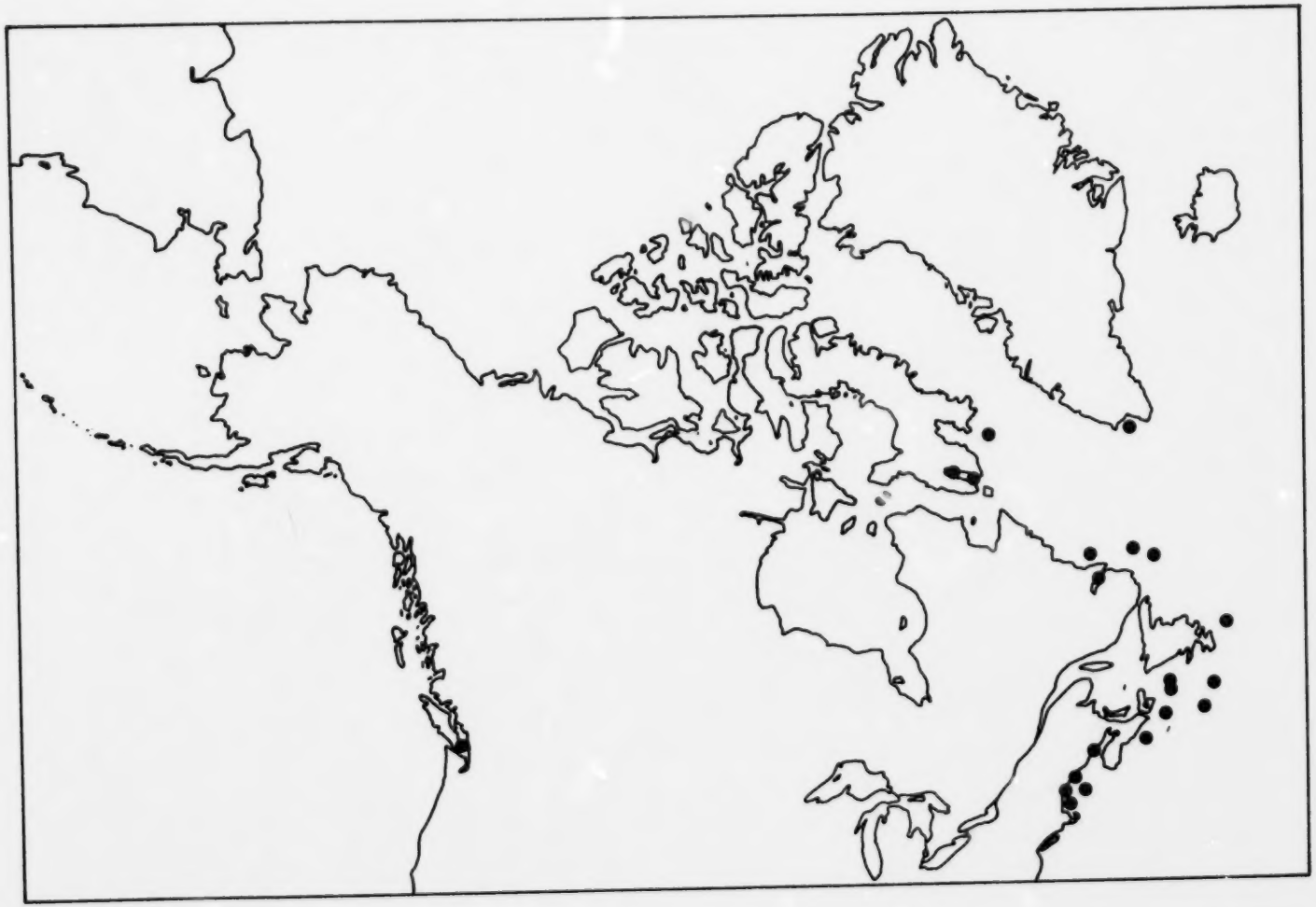
MAP 4: *Golfingia (T.) catharinae* □; *Golfingia (T.) pugettensis* ●.



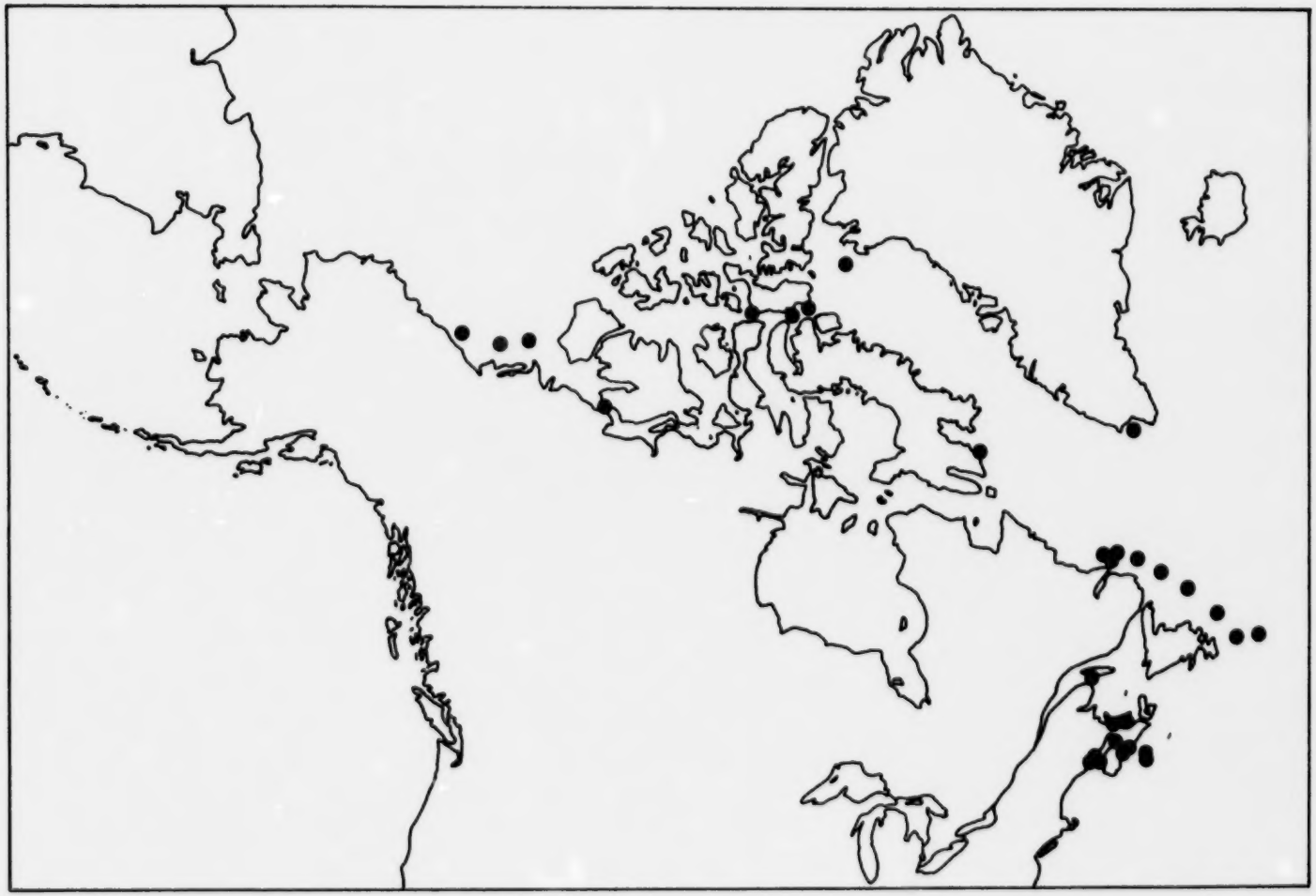
MAP 5: *Golfingia (G.) muricaudata* ■ ; *Golfingia (N.) lilljeborgi* ● .



MAP 6: *Golfingia (G.) margaritacea*.



MAP 7: *Golfingia (N.) eremita*.



MAP 8: *Phascolion strombi*.

MAP 9: *Phascolosoma (P.) agassizii*.

BIBLIOGRAPHY

Augener, H. 1903. Beiträge zur Kenntnis der Gephyreen nach Untersuchung der im Göttinger zoologischen Museum befindlichen Sipunculiden und Echiuriden. Archive für Naturgeschichte 69: 297-371.

Blainville, H.M.D. de. 1827. Dictionnaire des sciences naturelles. Vers. 49: 305-313.

Brawn, V.M., D.L. Peer and R.J. Bentley. 1968. Caloric content of the standing crop of benthic and epibenthic invertebrates of St. Margaret's Bay, Nova Scotia. Journal of the Fisheries Research Board of Canada 25(9): 1803-1811.

Bromley, J.E.C. 1979. A preliminary checklist of marine fauna of Minas Basin and Minas Channel. Proceedings of the Nova Scotia Institute of Science 29: 517-541.

Brunel, P. 1961. Liste taxonomique des invertébrés marins des parages de la Gaspésie identifiés au 3 août 1959. Cahiers d'Information Station de Biologie Marine de Grande-Rivière. No. 7, pp.1-9.

_____. 1970. Catalogue d'invertébrés benthiques du Golfe St-Laurent recueillis de 1951 à 1966 par la station de biologie marine de Grande-Rivière. Travaux sur les Pêcheries du Québec. No. 32, pp.1-55.

Chamberlin, R.V. 1919. Notes on the Supunculida of Laguna Beach. Pomona College Journal of Entomology 12: 30-31.

_____. 1920. The Gephyrea collected by the Canadian Arctic Expedition 1913-1918. Report of the Canadian Arctic Expedition 1913-1918. 9(D): 1-21.

Cutler, E.B. 1973. Sipuncula of the Western North Atlantic. Bulletin of the American Museum of Natural History 152 (Art. 3): 103-204.

_____. 1977. Marine flora and fauna of the northeastern United States. Sipuncula. NOAA Technical Report NMFS Circular 403. 6 pp.

_____. 1979. A reconsideration of the sipunculan taxa *Fisherana* Stephen, *Mitosiphon* Fisher and *Apionosoma* Sluiter. Zoological Journal of the Linnean Society 65: 367-384.

Cutler, E.B. and N.J. Cutler. 1980. Sipuncula collected by the R/V "Vema". Journal of Zoology (London) 190: 193-209.

Cutler, E.B. and V.V. Murina. 1977. On the sipunculan genus *Golfingia* Lankester, 1885. Zoological Journal of the Linnean Society 60: 173-187.

Danielssen, D.C. and J. Koren. 1881. Fraden norske Nordhavse expedition (1876-1878). 3. Zoologie. Gephyreer. Nytt Magasin for Naturvidenskapene 26: 44-66.

Edmonds, S.J. 1960. Sipunculids from New Zealand and the Chatham Islands. New Zealand Department of Scientific and Industrial Research Bulletin (139): 159-167.

Fisher, W.K. 1952. The sipunculid worms of California and Baja California. Proceedings of the United States National Museum 102: 371-450.

Gadd, G.G. 1911. Verzeichnis der Gephyreen des Kola-Golfes und zwei neue Species der *Phascolosoma*. Trudy Leningradadskogo Obshchestva Estestvoispytafelei 42: 79-93.

Gerould, J. 1913. The sipunculans of the eastern coast of North America. Proceedings of the United States National Museum 44: 373-437.

Gibbs, P.E. 1975. Gametogenesis and spawning in a hermaphroditic population of *Golfingia minuta* (Sipuncula). Journal of the Marine Biological Association of the United Kingdom 55(1): 69-82.

_____. 1977a. British sipunculans. Keys and notes for the identification of the species. Synopses of the British Fauna. No. 12. 35 pp. The Linnean Society of London. Academic Press.

_____. 1977b. On the status of *Golfingia intermedia* (Sipuncula). Journal of the Marine Biological Association of the United Kingdom 57: 109-112.

_____. 1982. The synonymy of the *Golfingia* species assigned to the *abyssorum* - section (Sipuncula). Sarsia. 67: 119-122.

Gosner, K.L. 1971. Guide to identification of marine and estuarine invertebrates. Cape Hatteras to the Bay of Fundy. pp.388-391. Wiley-Interscience, John Wiley & Sons, Inc., N.Y.

Grübe, E. 1868. Thätigheit der allgemeinen Naturwiss-section der schlesischen Gesellschaft im Jahr 1866. Jahres-Bericht der Schlesische Gesellschaft für vaterländische Kultur 45: 47-49.

Hérubel, M.A. 1906. Sur les sipunculides rapportés par l'Expédition Charcot. Note préliminaire. Bulletin du Muséum National d'Histoire Naturelle, Paris 12: 127-128.

Hyman, L.H. 1959. The protostomatous coelomates - phylum Sipunculida. *In* The Invertebrates, Vol. 5, pp.610-696. McGraw-Hill Book Co., N.Y.

Keferstein, W. 1863. Beiträge zur Kenntnis Gattung *Phascolosoma* F.S. Leuck. Untersuchungen über niedere Seethiere. Zeitschrift fuer Wissenschaftliche Zoologie 12: 35-51.

_____. 1865. Beiträge zur anatomischen und systematischen Kenntnis der Sipunculiden. Zeitschrift fuer Wissenschaftliche Zoologie 15: 404-455.

_____. 1867. Untersuchungen über einige amerikanischen Sipunculiden. Zeitschrift fuer Wissenschaftliche Zoologie 17: 44-55.

Kindle, E.M. 1917. Notes on the bottom environment of the marine invertebrates of western Nova Scotia. The Ottawa Naturalist 30(12): 149-154.

Kozloff, E.N. 1974. Keys to the marine invertebrates of Puget Sound, the San Juan Archipelago, and adjacent regions. p.124. University of Washington Press, Seattle.

Ledoyer, M. 1975. Aperçu sur le peuplement benthique des vases profondes du détroit de Gaspé (Golfe du Saint-Laurent). Travaux sur les Pêcheries du Québec 44: 1-27.

Lee, J.C. and N. Bourne. 1976. Marine resource inventory of Pacific Rim National Park. Fisheries Research Board of Canada Manuscript Report (Biology) 1389: 1-236.

Levings, C.D. 1976. Intertidal invertebrates and habitats at the Kitimat River estuary. Fisheries Research Board of Canada Manuscript Report (Biology) 1397: 1-15.

Linkletter, L.E., E.I. Lord and M.H. Dadswell. 1977. A checklist of marine flora and fauna of the Bay of Fundy. p.29. The Huntsman Marine Laboratory, St. Andrews, N.B.

Möbius, K. 1875. Vermes. V. Kommission zur Wissenschaftlichen Untersuchung des Deutchen Meere in Kiel. 1872-1873. pp.150-170.

Montagu, G. 1804. Description of several marine animals found on the south coast of Devonshire. Transactions of the Linnean Society of London 7: 61-85.

Murina, V.V. 1964. New and rare species of sipunculids of the genus *Golfingia*. Trudy Instituta Okeanologii Akademii Nauk SSSR 69: 216-253. (Russian with English summary).

_____. 1968. New data concerning the occurrence of abyssal sipunculids in the Atlantic Ocean. Zoologicheskii Zhurnal 47: 195-199. (Russian with English summary).

_____. 1973. New species of sipunculids in the Pacific Ocean. Zoologicheskii Zhurnal 52(6): 942-945. (Russian with English summary).

Ostroumov, A.A. 1909. The Gephyrea of the northern part of the Sea of Japan. Ezhegodnik Zoologicheskago Muzeya Imperatorskai Academii Nauk 14: 319-321.

Pergament, T.S. 1946. New genus and little known species of Sipunculida from the Arctic Ocean. Drifting Expedition of the Main Administration of the Northern Sea Route, on the ice-breaker G. Sedov, 1937-1940, 3: 189-193.

Pourtalès, L.F. de. 1851. On the Gephyrea of the Atlantic coast of the United States. Proceedings of the American Association for the Advancement of Science for 1851: 39-42.

Préfontaine, G. and P. Brunel. 1962. Liste d'invertébrés marins recueillis dans l'estuaire du Saint-Laurent de 1929 à 1934. Contributions du Ministère de la Chasse et des Pêcheries, Québec. No. 86: 237-263. *Also:* Naturaliste Canadien 89(8-9): 237-263.

Rice, M.E. 1967. A comparative study of the development of *Phascolosoma agassizii*, *Golfingia pugettensis* and *Themiste pyroides* with a discussion of developmental patterns in the Sipuncula. Ophelia 4: 143-171.

_____. 1973. Morphology, behavior and histogenesis of the pelagosphera larva of *Phascolosoma agassizii* (Sipuncula). Smithsonian Contributions to Zoology 132: 1-51.

Roule, L. 1898. Notes préliminaires sur les espèces de géphyreans recueillies dans les explorations sous marines du 'Talisman' et du 'Travailleur'. Bulletin Muséum National d'Histoire Naturelle, Paris 4: 384-387.

_____. 1907. Annélides et Géphyriens. Expéditions scientifiques du 'Travailleur' et du 'Talisman' 8: 1-102. Paris.

Sars, M. 1851. Beretning om en i Sommernen 1849 foretagen zoologisk Reise i Lofoten og Finmarken. Nytt Magasin for Naturvidenskapene 6: 121-211.

Selenka, E., J.G. de Man and C. Bulow. 1883. Die Sipunculiden: eine systematische monographie. *Reisen im Archipel Phillippen von Dr. C. Semper*, Pt. 2, 4: 1-131. Leipzig und Wiesbaden.

Shevtsov, V.V. 1972. Biocoenoses of bottom invertebrates of the shelf and the upper part of the slope in the Gulf of Alaska. Bonitation of the world ocean. Issue 2. VNIRO. Proc. 77: 153-167.

Sluiter, G.P. 1900. Géphyriens (Sipunculides et Echiurides) provenant des compagnes de l'Hirondelle et de la Princesse Alice. 1886-1887. Résultats des campagnes scientifiques accomplies sur son yacht par Albert Ier Prince souverain de Monaco 15: 1-30.

_____. 1912. Géphyriens (Sipunculides et Echiurides) provenant des campagnes de la Princesse Alice. 1898-1910. Résultats des campagnes scientifiques accomplies sur son yacht par Albert Ier Prince souverain de Monaco 36: 1-36.

Smith, R.I. and J.T. Carlton (ed.). 1975. Light's Manual: Intertidal invertebrates of the central California coast. pp.128-132. University of California Press, Berkeley.

Southern, R. 1913a. Oligochaeta, Gephyrea and Hirudinea of Clare Island. Proceedings of the Royal Irish Academy 31, pts. 48-50: 1-14.

_____. 1913b. Gephyrea of the coasts of Ireland. Fisheries, Ireland Scientific Investigations, 1912. No. III: 1-35.

Sparks, A.K. and W.T. Pereyra. 1966. Benthic invertebrates of the Southeastern Chukchi Sea. *In* Wilimovsky, N.J. and J.N. Wolfe, eds. Environment of the Cape Thompson region, Alaska. United States Atomic Energy Commission, Division of Technical Information. PNE 481, pp.817-838.

Stafford, J. 1912. On the fauna of the Atlantic coast of Canada. Third Report-Gaspé 1905-1906. Contributions to Canadian Biology 1906-1910: 45-67.

Stephen, A.C. 1965. A revision of the phylum Sipuncula. Annals and Magazine of Natural History, Series 13,7: 457-462.

Stephen, A.C. and S.J. Edmonds. 1972. The Phyla Sipuncula and Echiura. pp.2-342. British Museum (Natural History).

Stimpson, W. 1853. Synopsis of the marine invertebrata of Grand Manan; or the region about the mouth of the Bay of Fundy, New Brunswick. Smithsonian Contributions to Knowledge 6(5): 1-67.

_____. 1864. Descriptions of new species of marine invertebrates from Puget Sound, collected by naturalists of the North-west Boundary Commission, A.H. Campbell, Esq., Commissioner. Proceedings of the Academy of Natural Sciences of Philadelphia 16: 153-161.

Théel, H. 1905. Northern and Arctic invertebrates in the collection of the Swedish State Museum. I. Sipunculids. Kunglica Svenska Vetenskapsakademiens Handlingar 39(1): 1-130.

Verrill, A.E. 1873. Results of recent dredging expeditions on the coast of New England. American Journal of Science, series 3. 5: 98-106.

_____. 1874. Explorations of Casco Bay by the U.S.F.C. in 1873. Proceedings of the American Association for the Advancement of Science 22: 340-393.

_____. 1879. Annelides. *In* L. Kumlien, Contributions to the natural history of arctic America, made in connection with the Howgate Polar Expedition, 1877-78. Bulletin of the United States National Museum, No. 15: 141-143.

Wacasey, J.W. 1975. Biological productivity of the soutern Beaufort Sea: zoobenthic studies. Beaufort Sea Project, Technical Report No. 12b. 39 pp.

Wacasey, J.W., E.G. Atkinson and L. Kinlough. 1976. Zoobenthos data from James Bay, 1959, 1974. Canada Fisheries and Marine Service, Technical Report No. 661. 62 pp.

Wacasey, J.W., E.G. Atkinson, L. Derick and A. Weinstein. 1977. Zoobenthos data from the southern Beaufort Sea, 1971-1975. Canada Fisheries and Marine Service Data Report No. 41. 187 pp.

Wacasey, J.W., E.G. Atkinson and L. Glasspoole. 1979. Zoobenthos data from upper Frobisher Bay, 1967-1973. Canadian Data Report of Fisheries and Aquatic Sciences No. 164. 99 pp.

Whiteaves, J.F. 1874. Report on further deep-sea dredging operations in the Gulf of St. Lawrence, with notes on the present condition of the marine fisheries and oyster beds of part of that region. 6th Annual Report of the Department of Marine and Fisheries Canada. Appendix U, p. 178-204.

_____. 1901. Catalogue of the marine invertebrata of Eastern Canada. pp.88-89. Geological Survey of Canada.

Wildish, D.J. and R.L. Phillips. 1974. An identification strategem for benthos collected to assess marine and estuarine pollution. Fisheries Research Board of Canada Technical Report No. 450: 1-31.

Wildish, D.J. and A.J. Wilson. 1976. Check list for sublittoral macroinfauna sampled between 1970 and 1975 in four Bay of Fundy estuaries. Fisheries Research Board of Canada Manuscript Report (Biology) No. 1398: 1-12.

APPENDIX

The following is a list, by species, of the points plotted on the maps, followed by the source for the location. The list is arranged by ocean (Arctic, Atlantic, Pacific) and generally from north to south. Some of the information was obtained from the literature and is followed by the reference. In other cases, information was received from individuals or institutions about specimens in their collections. These locations are followed by an acronym for the person's name or the institution. The names and acronyms are as follows:

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National Museums of Canada
Ottawa, Ontario

St. Andrews Biological Station — SABS
St. Andrews, N.B.

British Columbia Provincial Museum — BCPM
Victoria, B.C.

Nova Scotia Museum — NSM
Halifax, N.S.

Arctic Biological Station — ABS
Ste. Anne de Bellevue, Qué.

National Museum of Natural History — USNM

United States National Museum

Washington, D.C.

British Museum (Natural History) — BM

London, England

Phascolopsis gouldii (Pourtalès, 1851) Map 1

St. Lawrence River estuary	(Préfontaine and Brunel, 1962)
Minas Basin, N.S.	(Bromley, 1979)
Bar Road, St. Andrews, N.B.	(SABS)
Indian Point, St. Andrews, N.B.	(SABS)
L'Etang estuary, N.B.	(SABS)
Casco Bay, Maine	(Gerould, 1913)

Golfingia (G.) birsteini Murina, 1973 Map 2

57°37'17"N, 148°34'5"W	(Murina, 1973)

Golfingia (G.) elongata (Keferstein, 1863) Map 1

47°51'N, 51°50'W	(Cutler and Cutler, 1980)

Golfingia (G.) margaritacea (Sars, 1851) Map 6

Arctic:

70°56'N, 132°33'W	(Wacasey et al, 1979)
South Bay, Southampton Is.	(NMNS)
71°51.7'N, 73°14.08'W	(NSM)
Brevoort Island	(Wacasey et al, 1980)
Frobisher Bay	(Wacasey et al, 1979)

Atlantic:

Gulf of St. Lawrence	(Whiteaves, 1901)
Green Bank, south of Newfoundland	(Gerould, 1913)
Misaine Bank, east of Cape Breton	(Gerould, 1913)
? Pictou Island, N.S.	(BM)

Pacific:

Pt. Gilmour, Montague Is., Alaska	(NMNS)
Wales Harbour, B.C.	(BCPM)
Dundas Island, B.C.	(BCPM)
Halibut Bank, B.C.	(NMNS, USNM)
Queen Charlotte Islands, B.C.	(NMNS)
50°23'N, 128°52'W	(NMNS)
Nanoose Bay, B.C.	(NMNS)
Canoe Pass, B.C.	(USNM)
48°54'N, 125°27'W	(NMNS)
Mill Bay, B.C.	(NMNS)
between Turn Is. and Flat Pt., Lopez Is., Wash.	(USNM)
Brown's Is., Wash.	(USNM)
False Bay, Wash.	(USNM)
off Foulweather Bluff, Puget Sd., Wash.	(USNM)

Golfingia (G.) muricaudata (Southern, 1913) Map 5

Fort Churchill, Hudson Bay	(NMNS)
49°48.2'N, 124°37.1'W	(BCPM)
48°54.5'N, 125°20.5'W	(BCPM)
48°38.8'N, 123°32.3'W	(BCPM)

Golfingia (G.) vulgaris (de Blainville, 1827) Map 3

53°35.1'N, 130°34.9'W	(BCPM)
50°06.0'N, 125°11.1'W	(NMNS)
Griffen Bay, San Juan Is., Wash.	(USNM)
48°7.2'N, 123°9.7'W	(USNM)

Golfingia (N.) capilleformis Murina, 1973 Map 2

56°14'1"N, 139°44'W	(Murina, 1973)
56°09'9"N, 139°12'6"W	(Murina, 1973)

Golfingia (N.) diaphanes (Gerould, 1913) Map 1

57°59'N, 54°06'W	(Cutler and Cutler, 1980)
50°53'N, 52°26'W	(Cutler and Cutler, 1980)
Georges Bank	(Gerould, 1913)

Golfingia (N.) eremita (Sars, 1851) Map 7

Arctic:

60°10'N, 47°08'W	(Cutler and Cutler, 1980)
60°10'N, 47°10'W	(Cutler and Cutler, 1980)
Davis Strait	(NMNS)
Frobisher Bay, Baffin Is.	(Wacasey et al, 1979)

Atlantic:

55°26'N, 58°09'W	(Cutler and Cutler, 1980)
54°27'N, 54°08'W	(Cutler and Cutler, 1980)
53°35'N, 58°37'W	(Cutler and Cutler, 1980)
50°53'N, 52°26'W	(Cutler and Cutler, 1980)
48°54'N, 51°08'W	(Cutler and Cutler, 1980)
eastern Grand Bank	(NMNS)
46°53'N, 58°31'W	(Cutler and Cutler, 1980)
46°39'N, 58°40'W	(Cutler and Cutler, 1980)
45°04'N, 59°46'45"W	(Gerould, 1913)
45°07'N, 55°09'W	(Gerould, 1913)
44°26'N, 57°11'15"W	(Gerould, 1913)
44°27'30"N, 62°33'30"W	(Gerould, 1913)
Gulf of St. Lawrence	(Whiteaves, 1901)
Passamaquoddy Bay, N.B.	(Chamberlin, 1920)
43°04'N, 70°30'W	(Gerould, 1913)
Casco Bay, Maine	(Gerould, 1913)
42°49'N, 68°50'W	(Gerould, 1913)
42°36'N, 70°27'W	(Gerould, 1913)
42°30 1/4'N, 70°38'W	(Gerould, 1913)

Pacific:

? Mill Bay, B.C.	(BCPM)

Golfingia (N.) lilljeborgi (Danielssen and Koren, 1881) Map 5

Arctic:

Beaufort Sea	(ABS)

Pacific:

48°43'N, 123°18'W	(NMNS)

Golfingia (N.) schuttei (Augener, 1903) Map 1

55°48'N, 56°00'W	(Cutler and Cutler, 1980)

Golfingia (N.) wodjanizki Murina, 1973 Map 2

55°20'5"N, 134°49'5"W	(Murina, 1973)
? 48°18.5'N, 123°12.8'W	(NMNS)

Golfingia (T.) catharinae (Grübe, 1868) Map 4

Mill Bay, Saanich Inlet, B.C.	(NMNS)

Golfingia (T.) pugettensis Fisher, 1952 Map 4

50°50.7'N, 127°20.5'W	(NMNS)
49°00'N, 125°20'W	(NMNS)
49°12.7'N, 123°27.7'W	(BCPM)
48°47'N, 123°12'W	(BCPM)
48°45.5'N, 125°32.0'W	(NMNS)
48°38.5'N, 123°32.1'W	(NMNS)
Plumper Sound, B.C.	(NMNS)
Nanoose Bay, B.C.	(NMNS)
Sidney Is., B.C.	(DVE)
Saanich Inlet, B.C.	(BCPM)
Griffen Bay, San Juan Archipelago, Wash.	(USNM)
San Juan Is., Wash.	(Fisher, 1952)
Dogfish Bay, Puget Sound, Wash.	(Fisher, 1952)

Phascolion strombi (Montagu, 1804) Map 8

Arctic:

76°00.8'N, 71°19.4'W	(NMNS)

75°50.7'N, 75°17.4'W	(NMNS)
74°10.9'N, 82°46.2'W	(NMNS)
71°22'N, 130°24'W	(Wacasey et al, 1977)
70°42'N, 134°45'W	(Wacasey et al, 1977)
70°14'N, 139°04'W	(Wacasey et al, 1977)
63°13'N, 64°08.3'W	(JWW)
60°10'N, 47°08'W	(Cutler and Cutler, 1980)
Atlantic:	
55°37'N, 56°08'W	(Cutler and Cutler, 1980)
55°35'N, 58°37'W	(Cutler and Cutler, 1980)
55°13'N, 57°00'W	(Cutler and Cutler, 1980)
54°27'N, 54°08'W	(Cutler and Cutler, 1980)
52°30'N, 54°24'W	(Cutler and Cutler, 1980)
50°53'N, 52°26'W	(Cutler and Cutler, 1980)
48°54'N, 51°08'W	(Cutler and Cutler, 1980)
46°44'10"N, 64°30'10"W	(SABS)
46°09'30"N, 63°45'10"W	(SABS)
46°04'40"N, 49°02'30"W	(Sluiter, 1900)
46°01'00"N, 62°12'20"W	(SABS)
45°57'15"N, 62°24'00"W	(SABS)
45°48'25"N, 63°03'00"W	(SABS)
43°31.9'N, 62°29.1"W	(NSM)
43°16'N, 62°07'W	(SABS)
43°03'00"N, 63°39'09"W	(Verrill, 1873)
between Prince Edward Island and Cape Breton Island	(Whiteaves, 1901)
throughout Northumberland Strait	(Whiteaves, 1901)
Walton, N.S.	(NSM)
Bay of Fundy	(Whiteaves, 1901)
Digby, N.S.	(NMNS; Kindle, 1917)
L'Etang Estuary, N.B.	(SABS)
Brandy Cove, N.B.	(SABS)

Grand Manan, N.B.	(Stimpson, 1853; Whiteaves, 1901)
Halifax, Harbour, N.S.	(NSM)
St. Margarets Bay, N.S.	(NSM; Brown et al, 1968)
La Have Bank, N.S.	(Whiteaves, 1901)

Themiste pyroides (Chamberlin, 1919) Map 3

54°43'N, 132°17'W	(NMNS)
Whiffen Spit, Vancouver Is., B.C.	(NMNS; BCPM)
bay west of Whiffen Spit, Vancouver Is., B.C.	(NMNS)
Crescent Beach, Olympic Peninsula, Wash.	(Rice, 1967)

Phascolosoma (P.) agassizii (Keferstein, 1867) Map 9

58°10'N, 135°28'W	(NMNS)
57°43'N, 136°16'W	(NMNS)
57°25'N, 135°52'W	(NMNS)
56°50'N, 135°39'W	(NMNS)
55°29'N, 133°19'W	(NMNS)
55°26'N, 133°18'W	(NMNS)
54°43'N, 132°17'W	(NMNS)
54°36.7'N, 130°47.8'W	(BCPM)
54°11'N, 130°48'W	(NMNS)
54°00.7'N, 130°38.8'W	(BCPM)
Yakan Pt., B.C.	(USNM)
Masset, B.C.	(USNM)
Langara Is., B.C.	(BCPM)
Refuge Is., Porcher Is., B.C.	(NMNS)
53°52'N, 133°19'W	(NMNS)
53°30'N, 132°45'W	(BCPM)
53°25'N, 135°40'W	(NMNS)
53°13'N, 132°04'W	(NMNS)
Seal Inlet, Graham Is., B.C.	(BCPM)
Frederick Is., B.C.	(NMNS)

off Sandspit, B.C.	(NMNS)
Port Louis, Graham Is., B.C.	(NMNS; BCPM)
Marble Is., B.C.	(NMNS)
52°46'N, 129°19'W	(NMNS)
52°12'N, 128°29'W	(NMNS)
52°08'N, 131°09.9'W	(NMNS, BCPM)
52°02'N, 127°52'W	(NMNS)
Tasu Sound, B.C.	(NMNS; BCPM)
51°58'N, 128°29'W	(NMNS)
51°56'N, 128°26.5'W	(NMNS)
51°49'N, 128°00'W	(NMNS)
51°47'N, 127°43'W	(NMNS)
51°39'N, 128°09'W	(NMNS)
Goose Bay, Rivers Inlet, B.C.	(BCPM)
50°50'N, 127°46'W	(NMNS)
50°50'N, 127°29'W	(NMNS)
50°29'N, 128°06'W	(NMNS)
50°05'N, 128°19'W	(NMNS)
Triangle Is., B.C.	(NMNS)
Canoe Pass, B.C.	(BCPM)
Bull Harbour, Hope Is., B.C.	(BCPM)
Round Is., B.C.	(USNM)
Dodd Narrows, B.C.	(BCPM)
False Narrows, B.C.	(BCPM)
Lennard Is., B.C.	(BCPM)
Nootka Sound, B.C.	(BCPM)
Clayoquot Sound, B.C.	(USNM)
Fisherman's Cove, B.C.	(USNM)
Frank Island, B.C.	(BCPM)
48°55.9'N, 125°17.8'W	(BCPM)

48°53.7'N, 125°19.2'W	(BCPM)
48°53.5'N, 125°22.75'W	(BCPM)
48°51.8'N, 125°9.65'W	(BCPM)
48°51'N, 125°12'W	(NMNS)
48°49'N, 125°13.5'W	(NMNS)
48°48.5'N, 125°13.5'W	(NMNS)
48°21'N, 123°43'W	(NMNS; BCPM)
48°19'N, 124°40'W	(NMNS)
Amphitrite Point, B.C.	(NMNS)
head of Bamfield Harbour, B.C.	(NMNS; BCPM)
Botanic Garden, Cape San Juan, B.C.	(NMNS)
Jacques Is., B.C.	(NMNS)
Bunsby Lagoon, B.C.	(NMNS)
Sea Lion rocks, Sooke, B.C.	(BCPM)
Saanich Inlet, B.C.	(BCPM)
Saturna Is., B.C.	(BCPM)
Victoria, B.C.	(BCPM)
Dicebox Is., Barkley Sound, B.C.	(BCPM)
Clo-oose, Vancouver Is., B.C.	(NMNS)
Fatty Basin, Barkley Sound, B.C.	(NMNS)
Gilbert Is., Barkley Sound, B.C.	(BCPM)
Effingham Bay, B.C.	(BCPM)
Bauke Is., B.C.	(BCPM)
Swiftsure Bank, B.C.	(BCPM)
Smuggler's Cove, Victoria, B.C.	(BCPM)
Esquimalt Harbour, B.C.	(BM)
Devil's Rock, B.C.	(USNM)
San Juan Strait, near south of Pysht R., Wash.	(USNM)
Friday Harbour, Wash.	(USNM)
Kanaka Bay, San Juan Islands, Wash.	(USNM)
Crescent Beach, Olympic Peninsula, Wash.	(Rice, 1967)
Cobb Seamount	(USNM)

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